TIP 283: Impact of Power Electronic Loads on Grid Stability

Context

Power electronic loads have voltage and frequency characteristics very different from conventional ones such as resistive or motor loads. Power electronic loads – electronically connected motor drives, battery chargers, consumer electronics, etc. – continually increase as a percentage of total system loads. Potential emergence of electric vehicles is expected to greatly increase power electronic load on the grid. Few studies have been done on understanding the impact that power electronic loads will have on power grid reliability.

Many major transmission paths in the Western Interconnection are voltage stability limited. Earlier research has shown that power electronic loads are constant power with respect to voltage and frequency; therefore, larger electronic loads will lead to degradation of frequency response, and the need for larger reserves carried by generators. Simulation studies suggest that constant power loads contribute to negative damping of grid oscillations and reduce synchronous stability.

Description

This project is based on initial research done under TIP 50 and 51. The fraction of power electronic loads is expected to increase over the next decade. The project will evaluate the impact of power electronic loads on power system stability, including dynamic voltage stability, damping of power oscillations, and frequency response. The project will look at a wide number of power electronic loads, such as variable frequency drives (VFD), consumer electronics, and Electric Vehicle Charges.

The project will simulate, test and evaluate various designs that make electronic loads friendly to the power grid. It will try to answer questions about system-wide impacts of the high penetration of power electronic loads on angular stability, voltage stability, oscillation damping and frequency response.

This project is coordinated with a larger nation-wide DOE CERTS project.

Why It Matters

BPA must be aware of risk to the system due to increasing power electronic loads. If the "unfriendly" response characteristics of power electronic loads result in stability constraints on the BPA system (such as voltage stability, undamped oscillations, frequency response, or angular instability), the transmission Available Transfer Capability (ATC) could be lost, thereby forcing BPA either to reduce transmission sales or make additional capital investments to restore the ATC.

Transmission investments and operational limits are largely driven by compliance with NERC Reliability Standards. Usually, transmission investments are needed to accommodate increases in load amount, new generation or transfer increase. However, some investments are now being driven by unfavorable changes in load characteristics, as with Fault Induced Delayed Voltage Recovery (FIDVR).

Further, it is very important to model the potential impact of power electronic loads so they can be addressed in a timely manner without unexpected violations of NERC TPL Standards. Thus, better understanding of the reliability risks in the Pacific Northwest associated with increasing penetration of power electronic loads may be crucial to maximum system delivery.

Goals and Objectives

- Conduct studies, simulations, testing and evaluation of grid-friendly solutions.
- Size the impact of new loads on the Pacific Northwest grid.
- Develop new "grid-friendly" strategies for power electronic loads.
- Perform solution simulations in PSCAD and testing in BPA lab.
- Continue providing technical support to DOE in their effort to make end-uses grid friendly.

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Project Start Date: October 1, 2012

Project End Date: September 30, 2016

Reports & References (Optional)

Links (Optional)

Participating Organizations

DOE CERTS Program
(Department of Energy: Consortium for Electric Reliability Technology Solutions)

Funding

Total Project Cost:	$185,542
BPA Share:	$185,542
External Share:	$0
BPA FY2014 Budget:	$61,000

For More Information Contact:

BPA Project Manager:
Steve Yang, hyang@bpa.gov

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